NORDIC STRUCTURES

Dead Loads

Definition

Dead load means the weight of all permanent structural and non-structural components of a building.

Dead Loads

1) The specified dead load for a structural member consists of:
   a) the weight of the member itself,
   b) the weight of all materials of construction incorporated into the building to be supported permanently by the member,
   c) the weight of partitions,
   d) the weight of permanent equipment, and
   e) the vertical load due to earth, plants and trees.
2) Except as provided in Sentence (5), in areas of a building where partitions, other than permanent partitions, are shown on the drawings, or where partitions might be added in the future, allowance shall be made for the weight of such partitions.
3) The partition weight allowance referred to in Sentence (2) shall be determined from the actual or anticipated weight of the partitions placed in any probable position, but shall be not less than 1 kPa over the area of floor being considered.
4) Partition loads used in design shall be shown on the drawings as provided in Clause 2.2.4.3.(1)(d) of Division C of NBC 2020.
5) In cases where the dead load of the partition is counteractive, the load allowances referred to in Sentences (2) and (3) shall not be included in the design calculations.
6) Except for structures where the dead load of soil is part of the load-resisting system, where the dead load due to soil, superimposed earth, plants and trees is counteractive, it shall not be included in the design calculations. (See Note A-4.1.4.1.(6) of NBC 2020)

Note: Except as required for earthquake load calculations, additional partition loads need not be considered in design of residential construction. For construction detail, refer to *Non-Load-Bearing Partitions on APA Structural Panel Floors*.

Commentary – Weights of Materials and Construction

Engineers and architects cannot be responsible for circumstances beyond their control. Experience has shown, however, that conditions are encountered which, if not considered in design, may reduce the future utility of a building or reduce its margin of safety. Among them are:

1) Dead Loads. There have been numerous instances in which the actual weights of members and construction materials have exceeded the values used in design. Care is advised in the use of tabular values.
2) Future Installations. Allowance should be made for the weight of future wearing or protective surfaces where there is a good possibility that such may be applied. Special consideration should be given to the likely types and position of partitions, as insufficient provision for partitioning may reduce the future utility of the building.

Attention is also directed to the possibility of temporary changes in the use of a building, as in the case of clearing a dormitory for a dance or other recreational purpose.

References

APA Technical Note B429, Non-Load-Bearing Partitions on APA Structural Panel Floors
APA Technical Topic TT-006, Ceramic Tile Over Wood Structural Panel Floors
APA Technical Topic TT-019, Approximate Engineering Dead Load Weights of Wood Structural Panels
ASCE, ASCE/SEI 7-22, Minimum Design Loads for Buildings and Other Structures, Section C3.1.2
Canadian Wood Council, Engineering Guide for Wood Frame Construction, 2014 Edition, Section 4.2.1.2
CCBFC, NRCC 56190, National Building Code of Canada 2020, Article 4.1.4.1.
International Code Council, International Building Code 2018, Table 1604.3
Marble Institute of America (www.marble-institute.com)
Tile Council of America (www.tileusa.com)
TCNA, What is the acceptable deflection for a floor that will be tiled? (https://www.tcnatile.com/faqs/30-deflection.html)
TTMAC, Deflection Limitations By Dale Kempster (http://ttmac.com/en/deflection-limitations)
Woeste F., Nielsen P., Ceramic Tile on Wood Floors

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Floor Dead Loads

Considerations for Ceramic or Stone Tile Floor Finishes

Special considerations apply when sizing floor joists to support ceramic or stone tiles (marble, granite, limestone, slate, etc.):

1. Tile industry associations recommend that floor joists be spaced 16 inches on centre or less.
2. The dead load in the tiled area will be higher than the typical 10 psf associated with carpet and vinyl finishes. See some examples below.
3. Tile industry associations recommend special total load deflection limits, measurable both as the length of the span, as well as between joists:
   a) Ceramic tile – total load deflection shall not exceed L/360 (Tile Council of America)
   b) Stone tile – total load deflection shall not exceed L/720 for spans up to 14 feet and a maximum deflection of 7/32 inch for spans greater than 14 feet (Marble Institute of America)
4. Two key reasons for cracks in tile floors are flexibility of floor sheathing and discontinuity in the subfloor surface. The Marble Institute recommends installation of two layers of sheathing, with the following conditions:
   a) Total sheathing thickness of 1-1/4 inch (minimum).
   b) Joints in the upper layer ("underlayment") offset with respect to joints in the lower layer (structural subfloor).
   c) Discontinuity in floor joists should also be considered, such as at the ends of joists at or over a girder.
5. Differential deflection, the deflection of one joist relative to another, must be considered when designing either a marble or ceramic tile floor system.

Recent research has shown tile to fail, under some conditions, when the floor is more rigid than L/360. In fact, failures at L/600 have been observed. It is for this reason that recommendations for floor rigidity are not based on deflection measurements but on empirically established methods found to work over normal code construction.

Examples of Typical Residential Floor Assemblies

The following tables list the components and weights of typical floor systems, along with the deflection limits that apply. Adjust the dead load as required to reflect the actual system components if they differ from those shown below and apply the appropriate deflection limit for the type of tiles to be used. The weight of actual components should be verified with the products' manufacturers. The weight is based on I-joist depths up to 11-7/8 inches and a minimum I-joist spacing of 12 inches.

Typical Residential Floor Assemblies

Assembly	Thickness (in.)	Weight (psf)	Reference
Floor 1			
Linoleum or asphalt tile	1/4	1.0	ASCE/SEI 7-22
Wood structural panel sheathing	5/8	2.1	APA TT-019
Nordic I-joists, 11-7/8 in. depth		3.5	Nordic NS-GT3-CA-en
Gypsum board ceiling	1/2	2.2	ASCE/SEI 7-22
Miscellaneous		1.5	
TOTAL		10	
Total load deflection limit		L/240	IBC 2018, Table 1604.3
Floor 2			
Hardwood flooring	7/8	4.0	ASCE/SEI 7-22
Wood structural panel sheathing	3/4	2.5	APA TT-019
Nordic I-joists, 11-7/8 in. depth		3.5	Nordic NS-GT3-CA-en
Gypsum board ceiling	1/2	2.2	ASCE/SEI 7-22
Miscellaneous		1.5	
TOTAL		14	
Total load deflection limit		L/240	IBC 2018, Table 1604.3
Floor 3			TCA Method F144
Ceramic tile	3/8	4.5	ASCE/SEI 7-22
Cementitious backer	1/4	5.0	Woeste F., Nielsen P.
Wood structural panel sheathing	7/8	3.0	APA TT-019
Nordic I-joists, 11-7/8 in. depth		3.5	Nordic NS-GT3-CA-en
Gypsum board ceiling	1/2	2.2	ASCE/SEI 7-22
Miscellaneous		1.5	
TOTAL		20	
Total load deflection limit [(a)]		L/360	Tile Council of America

a) Design floor areas over which tile is to be applied to have a deflection not greater than L/360 of the span when measured under 300 lbf concentrated load.

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Typical Residential Floor Assemblies (continued)

Assembly	Thickness (in.)	Weight (psf)	Reference
Floor 4			TCA Method F145
Ceramic or quarry tile	3/8	4.5	ASCE/SEI 7-22
Mortar bed	3/4	10.5	ASCE/SEI 7-22
Wood structural panel sheathing	3/4	2.5	APA TT-019
Nordic I-joists, 11-7/8 in. depth		3.5	Nordic NS-GT3-CA-en
Gypsum board ceiling	1/2	2.2	ASCE/SEI 7-22
Miscellaneous		1.5	
TOTAL		25	
Total load deflection limit		L/360	Tile Council of America
Floor 5			
Hardwood flooring	7/8	4.0	ASCE/SEI 7-22
Concrete topping	1-1/2	18.0	ASCE/SEI 7-22
Nordic I-joists, 11-7/8 in. depth		3.5	Nordic NS-GT3-CA-en
Gypsum board ceiling	1/2	2.2	ASCE/SEI 7-22
Miscellaneous		1.5	
TOTAL		29	
Total load deflection limit [(a)]		L/240	IBC 2018, Table 1604.3

a) Design floor areas over which tile is to be applied to have a deflection not greater than L/360 of the span when measured under 300 lbf concentrated load.

NORDIC STRUCTURES

Roof Dead Loads

Examples of Typical Residential Roof Assemblies

The following tables list the components and weights of typical roof systems, along with the deflection limits that apply. Adjust the dead load as required to reflect the actual system components if they differ from those shown below. The weight of actual components should be verified with the products' manufacturers. The weight is based on I-joist depths up to 16 inches and a minimum I-joist spacing of 12 inches.

Typical Residential Roof Assemblies

Assembly	Thickness (in.)	Weight (psf)	Reference
Roof 1 - Sloped roof			
Asphalt or wood shingles		3.0	ASCE/SEI 7-22
Wood sheathing	1/2	1.5	ASCE/SEI 7-22
Nordic I-joists, 16 in. depth		4.0	Nordic NS-GT3-CA-en
Batt insulation	3-1/2	2.5	ASCE/SEI 7-22
Gypsum board ceiling	1/2	2.2	ASCE/SEI 7-22
Miscellaneous		1.0	
TOTAL		14	
Total load deflection limit		L/240	IBC 2018, Table 1604.3
Roof 2 - Cold flat roof			
Five-ply felt and gravel		6.0	ASCE/SEI 7-22
Wood structural panel sheathing	1/2	1.5	ASCE/SEI 7-22
Wood furring		2.5	ASCE/SEI 7-22
Nordic I-joists, 16 in. depth		4.0	Nordic NS-GT3-CA-en
Batt insulation	3-1/2	2.5	ASCE/SEI 7-22
Gypsum board ceiling	1/2	2.2	ASCE/SEI 7-22
Miscellaneous		1.0	
TOTAL		20	
Total load deflection limit		L/240	IBC 2018, Table 1604.3
Roof 3 - Warm flat roof			
Five-ply felt and gravel		6.0	ASCE/SEI 7-22
Foam insulation	3-1/2	5.3	ASCE/SEI 7-22
Wood structural panel sheathing	1/2	1.5	ASCE/SEI 7-22
Wood furring		2.5	ASCE/SEI 7-22
Nordic I-joists, 16 in. depth		4.0	Nordic NS-GT3-CA-en
Gypsum board ceiling	1/2	2.2	ASCE/SEI 7-22
Miscellaneous		1.0	
TOTAL		22	
Total load deflection limit		L/240	IBC 2018, Table 1604.3